

During the 2020 Virtual Leadership Symposium, we received great questions for the session - *Stump the Chumps: How to Optimize Critical Facilities*. Since we were not able to address all the questions asked, we developed this document to provide additional responses. Each question is sorted by facility type.

General:

1. *In the post-COVID world, do you expect other new restrictions will make energy efficiency in critical facilities more difficult?*
 - **Wendell Brase response:** Policy-makers and code-writers often adopt a “more is better” type of response to airborne hazard reduction. One already hears simplified “answers” being suggested such as increased air-changes, which means higher airspeeds coming from supply diffusers that are typically designed to diffuse and mix air in a space for temperature consistency. This could be very detrimental to control of airborne hazards of all types, including pathogens. Safer practices need to be evidence-based, which means that quality of ventilation, delivery dispersion, airflow patterns, and effectiveness of airborne hazard removal are more important than mere quantity of airflow. Such research exists for laboratories, which is likely transferrable and applicable to infection control settings.
2. *Where do passive strategies play in the realm of critical facilities? Any successful case studies of solar pre-heat of ventilation air etc.*
 - **Wendell Brase response:** In some climates (such as UC Irvine enjoys), buildings with exposed (uninsulated), thermally massive (12 inches or more thick), poured concrete walls save about 8 percent overall in annual space conditioning.

Data Centers:

1. *What new technologies are coming down the pipeline for data centers?*
 - **Dale Sartor response:** Some new technologies in the pipeline for data centers include:
 - Warm liquid cooling: Air is a poor heat transfer mechanism and as data centers become more dense liquid cooling becomes a viable option. The closer to the heat source the liquid is, the more efficient the system. Liquid to the chip options allow the fluid to run warm (e.g. 120degF). At such temperatures it will be possible to cool data centers without compressor cooling and without cooling tower water consumption (dry coolers). Further the opportunities for heat recovery and reuse become more feasible.
<https://datacenters.lbl.gov/technologies/liquid-cooling>
 - DC Powering: Typical power in a data center undergoes multiple conversion between AC and DC (and back) as well as changes in voltage. Every conversion is a point of inefficiency and heat loss. DC powering can be a simpler, more reliable, and more efficient alternative. Not only does DC power interface well with IT equipment it is well suited for micro-grids.
<https://datacenters.lbl.gov/technologies/power>
 - Redundancy in the Network rather than in the data center: Historically, reliability of mission critical data centers depended on high levels of redundancy in the mechanical and electrical infrastructure systems. Virtualization has enabled applications to be available at multiple geographic sites. This redundancy in the network can be more robust and efficient than redundancy at the site.

2. What about non-pure-play Data Centers positioned inside of other facilities? Reusing the heat to other parts of the building?
 - **Dale Sartor response:** Small embedded data centers offer greater challenges as well as opportunities (<https://datacenters.lbl.gov/small-data-centers>). While on one hand there is a shift to centralization and the “cloud,” there is an emerging need for so called “edge” data centers close to the users. Locating data centers close to a “thermal host” (e.g. a building that needs heat) does offer an opportunity for heat reuse.
3. Do you think that the 'utilization' you spoke about in Data Centers can be used similarly on the equipment in other critical facilities?
 - **Dale Sartor response:** Increasing utilization of resources typically makes sense in many applications. For example, shared equipment in laboratories does offer similar savings opportunities especially when those resources are typically left powered on with no productive work being done (e.g. fume hoods in a wet laboratory).

Laboratories:

1. *Do Smart Labs cost a lot more than regular buildings? Do they require higher soft costs in terms of personnel time and skillset?*
 - **Wendell Brase response:** Yes and yes. The initial capital cost increment for a “smart lab” vs. a code-compliant lab without “smart lab” attributes is in the range of 7-8 percent. We use a set of life-cycle standards in combination with a set of cost management strategies, so that the latter yield savings sufficient to cover the capital cost increment of “smart labs” design. Let me know if you would like a copy of this tool, which is outlined in a short paper we have used for several decades (even before we adopted the Smart Lab standards). My email is wcbraze@uci.edu. The operating costs are a mixed set of factors, of which the utility savings are massive compared to the ongoing costs of maintaining a “smart” lab. Actually, there are about ten cost factors – mostly savings benefits, and a few incremental operations costs. I have several slides that display 50-year life-cycle costs and benefits for both new construction and retrofit of existing labs using the full “smart lab” set of features.
2. *Since your labs have excellent ventilation, can you justify returning to your labs sooner with the COVID-19 pandemic?*
 - **Wendell Brase response:** Our Smart Labs program continues to produce new evidence on diffuser design, supply and exhaust location, and other factors that characterize the quality of ventilation, exhaust, and airborne hazard removal. Some of this research is in pre-publication now, which means that it is so new that we are not modifying guidelines currently in place regarding re-occupancy. Another positive benefit of Smart Lab design is that the reduced fan-speeds and airspeed through the filtration media enable use of MERV-14 filters. This yields a significant reduction in airborne hazards that are transported via particulates.
3. *Do your finely tuned lab tactics trickle into the adjoining office-space in the same building?*
 - **Wendell Brase response:** In new construction, we use a number of “smart” features to attain energy performance ~50 percent better than Title 24, although the number of sensor inputs is vastly simpler in non-lab facilities.